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APOLLO MONTHLY PROGRESS REPORT

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NAS9-150

1 December 1963

Paragraph 8.1, Exhibit I

Report Period
16 October to 15 November 1963

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NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

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ILLUSTRATIONS

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PROGRAM MANAGEMENT

STATUS SUMMARY

The Apollo pad abort test vehicle, boilerplate 6, was successfully launched from WSMR on 7 November (see Figure 1). The flight was made to demonstrate the capability of the launch escape subsystem. No holds were encountered during the countdown and the boilerplate was launched on schedule at 9 AM MST. The launch escape tower and the forward heat shield jettisoned 15.6 seconds after launch at 5600 feet, followed by drogue parachute deployment at 18.6 seconds from launch. The earth landing subsystem functioned normally, and telemetry indicated that all functions performed within design parameters. The command module was returned to S&ID after the test to be used in parachute recovery system tests.

More detailed information on the launch escape test is contained in the Aerodynamics and Vehicle Testing subsections of this report (pp 5, 25), and in the WSMR subsection of the Operations section (p 30).

SUPPLEMENTAL AGREEMENTS, CONTRACT NAS9-150

The fully executed supplemental Agreement 2 has been received from NASA. This supplemental agreement is similar to Amendment 28 to Letter Contract NAS9-150, and provides for contract change authority (CCA) requests resulting from technical directions from the project officer representatives at Downey, WSMR, and the Florida facility.

Supplemental Agreement 3, which provides generally for the adoption of Master Development Schedule 7 into the contract, has been executed by NASA and S&ID.

Supplemental Agreement 5, which provides for PERT and companion cost reporting of facilities, has been executed by NASA and S&ID.

Supplemental Agreement 6, which deletes from Contract NAS9-150 the spare parts provisioning procedure and substitutes the overhaul and repair and spares provisioning procedure, has been executed by NASA and S&ID.

Supplemental Agreement 7, which deletes from Contract NAS9-150 the ground support equipment provisioning procedure and substitutes the newly rewritten ground support equipment provisioning procedure of 17 September 1965 has been executed by NASA and S&ID.

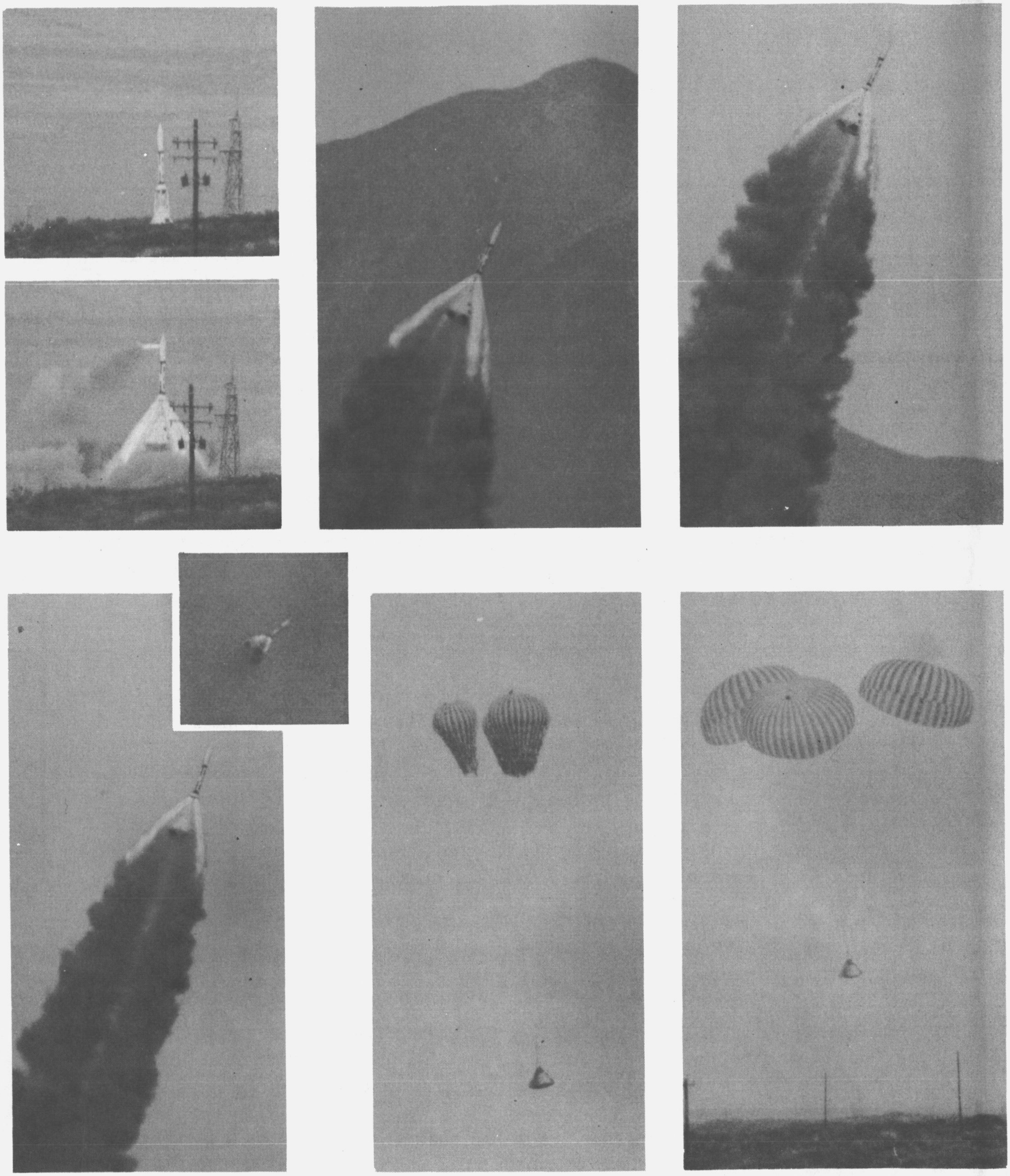

Figure 1. Single-Frame Sequence of Boilerplate 6 Launch

SUBCONTRACTOR STATUS

Contracts

Negotiations have been completed with all thirteen major subcontractors. Aeronca, Avco, Beech, Link, Lockheed, Honeywell, and Thiokol have acknowledged and returned the signed definitive purchase order to S&ID.

Prelaunch Auxiliary Checkout Equipment (PACE) Command System

Facility surveys are being conducted by S&ID of the six firms selected to bid on the PACE command system. The surveys are scheduled to be completed during the next period.

LOGISTICS ENGINEERING

Preliminary review copies of the Flight Crew Operations Manual were sent to Engineering for an engineering check. This is the first input to NASA and will be delivered on 15 December 1963 for their evaluation of format and technical content.

LOGISTICS

Supply Support

With the completion of the test on boilerplate 6, screening of spares inventory at WSMR was begun in order to determine disposition of residual stocks. Approximately 51 percent of the total range of spares line items has been released in support of program hardware as shown in Table 1.

Table 1. Spares Released

Spares in Support of	Released During Report Period	Cumulative Releases to Date
GSE	321	5,996
Spacecraft	491	4,087
Bulk items	36	4,113
Trainers		11
Total	848	14,207

Contractual authority was received and internal procedures are being defined to allow the start of repair, overhaul, and modification of support hardware.

Test Support

The status in support of test site operations for the report period is as follows:

Table 2. Test Site Operations Support

Test Site Requirements	AMR	ATO and Test Preparation (Downey)		WSMR	El Centro	Total
Backlog as of 15 October 1963	37	13		2,132	2	2,184
Received	88	22	229	689	2	1,030
Shipped	37	30	46	896	3	1,012
Outstanding	88	5	183	1,925	1	2,202

Operations Control

A project coordination section was established within the support integration unit of Apollo Logistics Operations Control Group. Individual logistics project coordinators have been assigned to each Apollo test vehicle. Each will be responsible to monitor over-all Logistics support actions and coordinate with responsible S&ID organizations and the appropriate test sites to align support effort.

DEVELOPMENT

AERODYNAMICS

Analysis is continuing of simulation requirements for the FD-6 dynamic damping wind tunnel test series. The FD-6 model is a one-tenth scale command module/tower flap configuration suitable for free oscillation damping tests. The range of flight parameters (such as Mach and Reynolds numbers) encountered during actual flight is being determined. Flight regimes in which adverse dynamic damping characteristics might cause unstable flight are being defined. These data will aid in establishing a final run schedule. A need to obtain data about yaw and pitch axes is under consideration.

Using jet model test data, the critical angles of attack exceeding command module design loads were determined as a function of flight Mach number. The minimum critical angle of attack, 21.5 degrees during launch escape subsystem (LES) motor thrust buildup and 23 degrees during thrust tail-off, occurs at Mach 2. Above Mach 2, the critical angle of attack increases rapidly. The command module can withstand tumbling during motor burning at Mach numbers greater than 3.5.

Drag from flight testing of Little Joe II (round quality verification test 1) was determined from preliminary test data supplied by NASA. The zero thrust drag coefficient in the range M = 0.6 to 0.7 is $C_D = 0.54$, about 13 percent higher than previous NASA estimates.

Tests of the 0.045 scale model of the command module/escape tower in the AEDC tunnel C (Mach 10) were delayed approximately four weeks because of compressor and heater failures. Tests originally scheduled for Mach 10 to determine roll effects of the lee-side antenna will now be conducted at M = 6 in tunnel A. The antenna tests were added to the previously scheduled tunnel-A program in which tower flap effectiveness will be determined for Mach numbers ranging from 3 through 6.

Predicted flight parameters for boilerplate 6 were re-calculated according to the weight data and thrust vector alignment data obtained at WSMR during the past report period. Very little revision in the predicted values was found to be necessary. Actual flight data, obtained at launch of boilerplate 6 on 7 November by tracking and telemetry, very closely paralleled these revised calculations. (See Table 3.)

Table 3. Boilerplate 6 Flight Parameters

Parameters	Predicted	Actual
Altitude at tower jettison	4,900 feet	5,148 feet
Range at tower jettison	4,350 feet	4,292 feet
Maximum angle of attack	11 degrees	12 degrees
Maximum velocity (M)	Mach 0.7	Mach 0.66
Maximum dynamic pressure (q)	595 psf	519 psf

These and other actual significant parameters were closely duplicated with the digital computer simulation through use of the meteorological and thrust data obtained during the test. Further studies are in progress to duplicate the actual flight parameters. The results will be summarized in the 30-day report on the boilerplate 6 test.

MISSION DESIGN

Studies indicate that the basic management of the spacecraft attitude for thermal control is not feasible, except for transient effects to offer some load relief to the environmental control subsystem (ECS) command module cabin temperature control and the electrical power subsystem (EPS) radiator subsystem control. Thermal control subsystems must be designed for worst-attitude situations throughout the mission. Areas included in these investigations are the requirements for command module cabin temperature control, command module ECS supplemental water cooling, EPS radiator subsystem, command module forward heat shield ablator, and the forward and aft ECS factors of the service module.

Boost trajectories for possible mission profiles of Saturn V Apollo development flights 504 and 505 of spacecrafts 029 and 032, respectively, were computed and compared with booster and spacecraft test objectives. These trajectories considered tracking and command module recovery area requirements. No class of trajectories was found to satisfy all NASA test objectives. NASA requires a trajectory that will duplicate a lunar mission and indicates that the use of a spacecraft system not directly involved in obtaining heat shield performance is not desirable. An unmanned guidance and navigation (G&N) subsystem cannot meet the requirement of a simulated lunar mission because of the long time and complex maneuvering required. The following are three possible alternatives.

1. Adopting a shorter mission flight with no service propulsion subsystem (SPS) firing

2. Designing an auxiliary subsystem capable of updating the G&N subsystem information

3. Making use of several manned spacecraft flights with small incremental changes in velocity

A study was begun using a three-dimensional model to determine the number of days of sunlight, darkness, and moonlight during the transposition and docking phase for various months during 1967 that include the dates of the vernal and autumnal equinoxes and the summer and winter solstices. Lighting conditions are a function of launch azimuth, launch window (north or south injection), time from translunar injection, and time of the month. Preliminary results show that, for a launch azimuth of 90 degrees, at a point on the translunar trajectory corresponding to 15 minutes after translunar injection, darkness occurs for the number of days indicated in Table 4.

Table 4. Lighting Conditions

Month	Number of Days in Darkness	
	North Injection	South Injection
March	4.7 (29 March to 3 April)	5.9 (30 March to 5 April)
June		4.2 (1 to 3 June, 26 to 28 June)*
September	5.6 (22 to 28 September)	5.1 (22 to 27 September)
December	6.4 (19 to 25 December)	

*Moon crosses node twice

For the periods of darkness shown above, in which this maneuver might be performed, preliminary results indicate that from 41 percent to 84 percent of the moon's disc will be visible from the spacecraft.

The effects of transport lag caused by computer sampling were investigated for a range radar damp navigation loop. The investigation was made because the velocity data as determined by the Apollo G&N computer may be derived too slowly, resulting in an indication that the ΔV requirement is excessive for the terminal phase of rendezvous. The present determination by both MIT and S&ID indicates that the computation cycle for velocity information for different phases of the Apollo mission lies between limits of 0.5 and 1 second. The results of the transient analysis study show that the transport lag of the computer coupled with the response lag of the navigation loop produces an effective lag in obtaining the true velocity data of three to four times the computation cycle time. A previous investigation of the effect of lag on terminal guidance efficiency shows that any lag greater than 0.1 second is undesirable. The results further show that for lags of 0.5 seconds the ΔV terminal rendezvous maneuver efficiency, as compared to the ideal impulse, reaches a low of 30 percent. Unless the transport lag introduced by the Apollo guidance computer can be reduced to less than 0.1 second, a direct range rate measurement capability will have to be provided in the service module radar.

CREW SYSTEMS

Fifteen checkout runs were completed by S&ID subjects on the AMAL Johnsville centrifuge using the S&ID test fixture. These simulation studies investigated crew vision and reach, couch hip angle, and space suit pressure parameters. An interface problem with the roll motion on the rotational controller and the outside arm support restraint is being studied. The Phase-I Apollo manned centrifuge test program began on schedule, using NASA astronaut subjects.

Studies are underway using the command module mock-up 2 to determine astronaut capabilities while the astronaut is wearing the Apollo Phase-B pressure suit assembly (Figure 2). Specific areas of investigation include the crew couch arm rest and restraint harness, reach and vision to main control and display panel, G&N sighting, lower equipment bay reach and clearances, and lunar excursion module transfer tunnel clearance. Preliminary mobility measurements and dimensions of the inflated suit were obtained in the S&ID workspace analyzer room using both Hulcher still photographs and motion picture records.

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Figure 2. Astronaut Wearing Unpressurized Suit, Strapped to Crew Couch in Command Module Mock-up

STRUCTURAL DYNAMICS

Acoustic testing of a 180-degree segment of the service module shell structure to explore structural response to acoustic excitation is 80-percent complete. Investigations of the response of the 70-degree and 50-degree panel sections to acoustic excitation show that the calculated responses agree closely with the test results. The 70-degree section first response was at 78 cps compared with 75 cps calculated, while the first mode of the 50-degree panel was found to be at 95 cps as compared to a computed value of 105 cps. The operation is not a structural proof test because the present capability of the test facility does not equal the expected flight environment.

Studies are being conducted to determine the effects, on the second stable flotation position of the command module, of shortening the upper tunnel section. A shorter tunnel is being studied in conjunction with the installation of the docking mechanism. Preliminary results show a much greater heel angle because of the loss of buoyancy at a comparatively large distance from the c. g. The tunnel is being shortened on the one-tenth scale flotation model to obtain experimental data to verify the calculations. Additional tests will be run with both the long and short tunnel configurations to obtain empirical data on righting moment versus heel angle for use in the digital computer flotation analysis program.

Bending modes of the docked service module/command module/lunar excursion module configuration are being investigated. Calculations were made for increased stiffness in the command module tunnel and the lunar excursion module to raise the fundamental frequency to avoid control system coupling problems. With present stiffness values, this frequency is approximately 11 radians per second for the lowest case. Because of the additional weight required to increase stiffness, the best method to avoid resonance problems will probably be the use of a compensating network in the control system.

STRUCTURES

The parachute deployment load was reduced from a 44,000-pound limit to a 37,500-pound limit, alleviating some of the problems associated with a rigid yoke design. Test data confirmed load analyses.

The SPS oxidizer qualification tank 1 successfully passed the burst test at 441 psig. The specification burst pressure is 350 psig.

The first qualification SPS 40-inch diameter spherical helium storage tank was successfully burst in a hydrostatic test at 7200 psig. The design burst strength is 6600 psig. Preliminary examination of the burst vessel disclosed that the fracture originated in the upper hemisphere at the heat-affected zone of the weld. The fracture traversed in full shear through the weld in one direction and into the membrane wall of the upper hemisphere in the opposite direction.

Development of the S-I and S-IVB adapter separation subsystems is in progress. Test firings of linear charges against the honeycomb panels reveal that changes are required. In certain areas the charges were not great enough to cut through the multiple thicknesses, and a second problem was caused by one charge damaging the adjacent backup charge. Charges will be increased from 25 to 50 grains where necessary, and a barrier will be installed between all pairs of charges as an integral part of the structure splice strips, except where honeycomb is to be cut. In the latter case, the barrier is to be incorporated in the charge holder. The necessary ordnance drawing changes are scheduled for completion in early December.

Investigations of different LES tower flap constructions show that the use of brazed stainless steel honeycomb PH15-7Mo will result in a 9.14-pound weight for a flap of 920 square inches as against a 13.75-pound weight for an aluminum flap. The heavier aluminum weight results from the lower strength of aluminum at elevated temperatures. The PH15-7Mo honeycomb 920 square-inch flap drawings are scheduled for completion in the next report period.

Design studies are in progress for an improved method of dual drogue parachute release compatible with the present structure. Problems were encountered in containing the blast from a 100-grain flexible linear shaped charge (FLSC). Initial test firings with a 50-grain FLSC showed that satisfactory separation of the dual drogue parachute release fittings can be obtained by the use of Inconel 318. Further tests are under way to determine if the blasts of these reduced charges can be satisfactorily contained.

FLIGHT CONTROL SUBSYSTEMS

Stabilization and Control Subsystem (SCS)

Acceptance tests on components of the stabilization and control subsystem (functional model A) were begun during the report period. These tests are the first in a series that will include cards assembled into the electronic control assembly packages.

A study was made and a plan of action submitted to NASA to investigate a portable attitude hand controller that could be readily moved from couch to couch. The G&N/SCS total attitude signal interface load requirements were defined, and the G&N/SCS signal interface was completely defined with MIT concurrence. Both definitions were transmitted to the SCS subcontractor.

The requirements for the attitude and system spacecraft 009 control programmer and its interface with the SCS were determined. A rough draft of the operational procedures for normal mission and abort was prepared for this spacecraft. Mounting requirements for two proposed 2-degree-of-freedom backup gyros were established, and an evaluation of available stock gyros is under way.

Electronic Interfaces

A fact-finding meeting was held with the in-flight test subsystem (IFTS) subcontractor in preparation for the contract negotiations scheduled for early December. Studies were begun on two vertical coldplate designs for use in the lower equipment bay. One design is based on present lower equipment bay package designs, the other on modularized packages. In either case, the packages would be attached to the vertical coldplate structure.

Flight Systems Analysis

Command module SCS and mission analyses established some of the entry design requirements for spacecraft 009. Initial studies of SCS failure effects indicated that further investigation should be made to determine techniques for monitoring RCS firings and to evaluate SCS redundancy, with a separate rate demodulator to be used for the backup rate. These studies are now being implemented.

The possible use of the lunar excursion module as a backup for the service propulsion subsystem is being studied to establish static control torque requirements if both stages of the lunar excursion module propulsion are used to provide ΔV corrections to the combined command/service module/lunar excursion module. The RCS torque capabilities for various command/service module/lunar excursion module weights and c. g. configurations were determined by considering the separate and the combined use of the service module and lunar excursion module reaction control subsystems. The scope of the study was limited to static control capabilities of the service module and lunar excursion module reaction control subsystems with existing mechanization. Findings indicate that static attitude control capability is feasible except for certain service module intermediate propellant loads and service module tank rupture.

TELECOMMUNICATIONS

Communications

The first two engineering models of the PCM telemetry equipment were completed. Acceptance tests were successfully completed on the first set and prototype design proof tests are under way. Preliminary acceptance tests were successfully performed on the second set. The third and fourth E-models are nearing completion.

A study was made to determine the advisability of moving the unified S-band equipment and the S-band power amplifier equipment from the command module to the service module (Figures 3 and 4). The change was proposed in an effort to reduce weight and improve the command module c. g. However, the results of the study showed a decrease of command module equipment weight between 43 and 57.5 pounds with an increase of service module equipment weight of 88 pounds, increased equipment complexity, a more severe environment, reduced reliability (from 0.999934 to 0.999101), and equipment delivery of the first unqualified item 14 months after receipt of order by the subcontractor. It was recommended that this equipment remain in the command module; NASA concurred.

Instrumentation

The char sensor developed by S&ID for use on the Apollo heat shield was successfully tested in a plasma jet, and satisfactory operation was confirmed in a relatively high enthalpy (high temperature environment, but in the absence of any erosive forces). Final verification and acceptance of the design will depend upon the result of rocket exhaust tests to be performed during the next report period.

Instrumentation systems were installed in boilerplates 12 and 13. Tests on the systems of boilerplate 12 will begin after required updating of the vehicle by Apollo Test and Operations. Electrical verification and systems checkout tests have been successfully completed on boilerplate 13. All instrumentation equipment is available for installation on boilerplates 15 and 23.

The procurement of 16mm special high-speed instrumentation camera subsystems for boilerplates 1, 2, and 28 was completed, and delivery was made on the units for boilerplates 1 and 2. Photographs taken with cameras in boilerplates 1 and 2 during ground and water impact tests indicated a need to strengthen the camera mounting structure. This modification will be incorporated for future tests.

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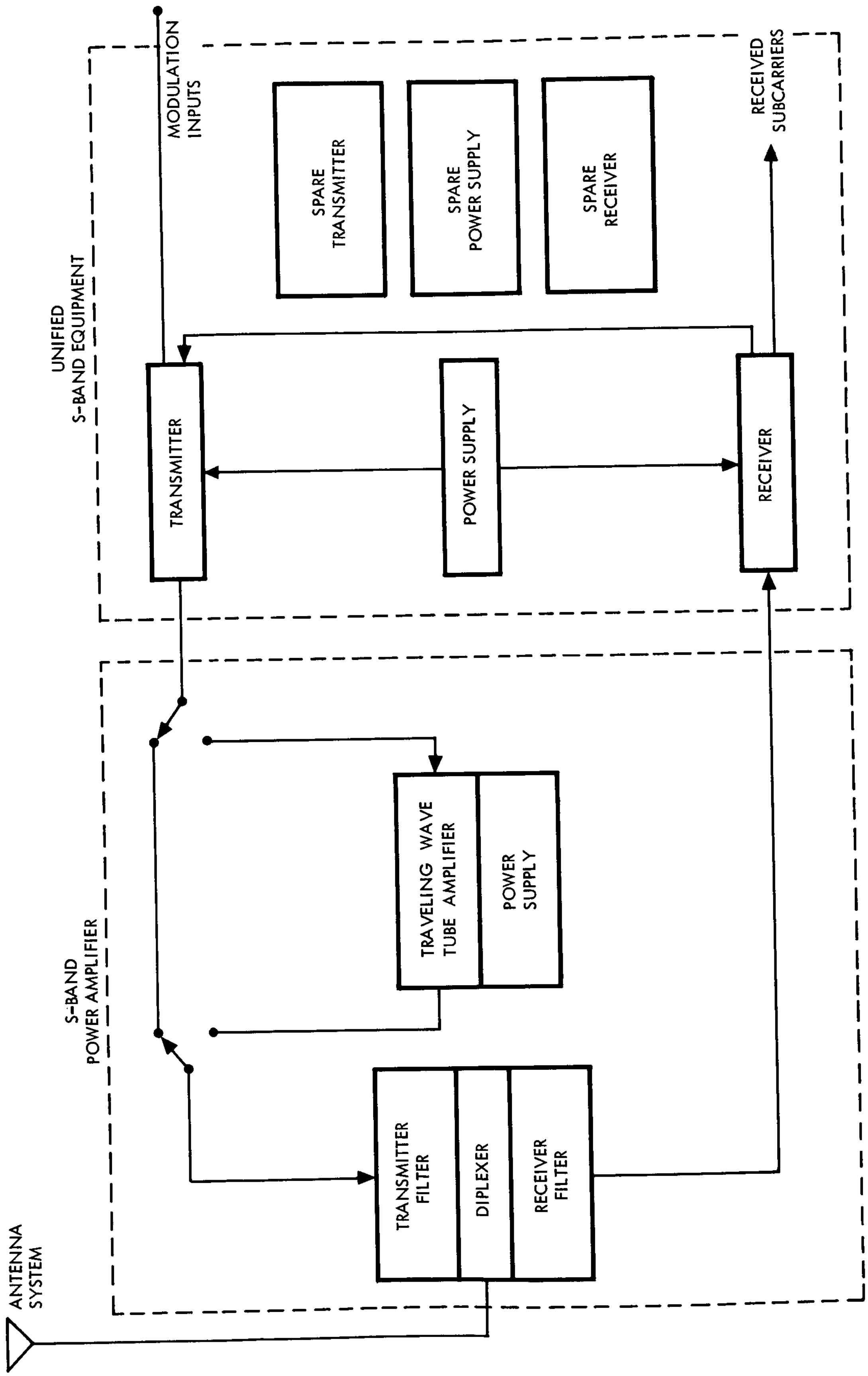

Figure 3. Present Location of S-Band Equipment in Command Module

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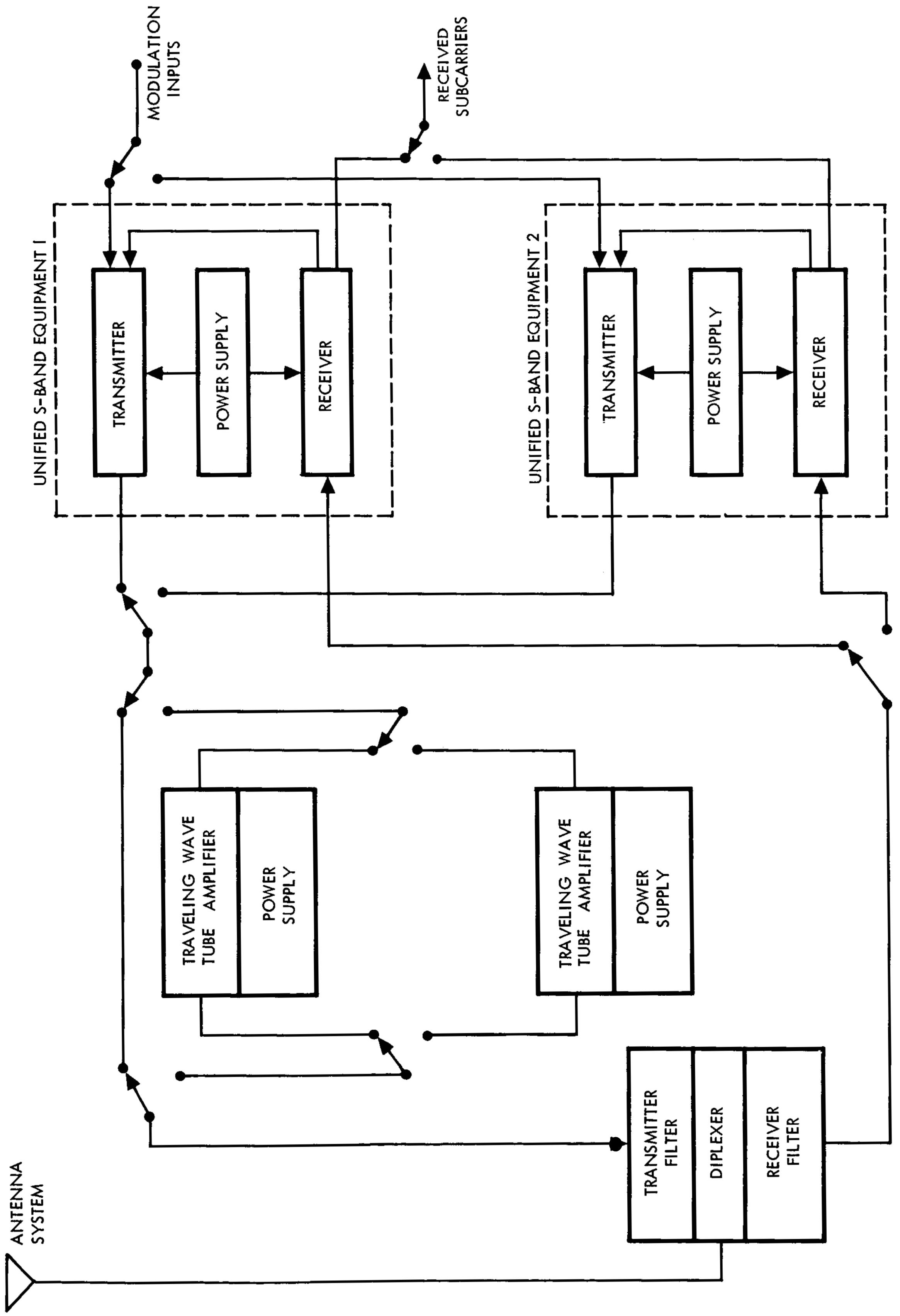

Figure 4. S-Band Equipment Required for Location in Service Module

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Instrumentation equipment lists were completed and are being released for Phase-I testing on fixture 2. Measurement lists and requirements lists are being implemented for Phase-II testing. Equipment lists and requirements lists are being released for boilerplate 14 and for spacecraft 001, 006, 008, 009, and 011. Procurement of instrumentation hardware for these vehicles was begun. Effort is being made to avoid a schedule slippage caused by equipment delivery problems.

ENVIRONMENTAL CONTROL SUBSYSTEM

Integrated ECS valve packaging is being incorporated to increase reliability and reduce weight. Modular casting techniques will integrate the valves into the glycol valve panel, the water valve panel, and the cabin heat exchanger valve panel. Because of the complexity of the oxygen valve panel, in-place brazing will be used.

Improvements in reliability result from the following factors.

1. The number of threaded fittings is reduced from 173 to 87.
2. The number of potential leaking joints is reduced.
3. The humidity buildup within the command module is lessened.
4. The interior atmospheric contamination is lessened.
5. The number of resonant frequency sources is reduced by decreasing the number of individual components.

In addition to increased reliability, the over-all weight of the valve package is reduced 40 percent, and the over-all volume is reduced 80 percent.

Calculations were made of the radiation dose in 30 cases of anisotropic proton penetration of the spacecraft, using the April 1963 NASA-MSC environmental criteria. Results show that the dose can range from 340 to 600 rads, depending upon spacecraft orientation, using a 24-hour anisotropy with respect to the proton beam. The studies show that orientation of the spacecraft must be known by the astronaut within an approximate 10-degree range if a significant dose reduction is to result from anisotropic considerations.

A preliminary study of condensate in the cabin air heat exchanger indicates that moisture will not be entrained in the air stream, but will flow on the metal enclosure and be collected in the water accumulator for re-use.

Convective heating rates and surface shear stresses were determined for a ballistic entry from a 100 nautical-mile orbit (the entry following a decay to 400, 000 feet). The maximum convective heat flux associated with this long entry time (6500 seconds) is 123 Btu per square foot-second, with a corresponding maximum heat load of 42, 215 Btu per square foot. The corresponding values for a 2.14-g entry from a lunar mission are 327 Btu per square foot-second and 107, 296 Btu per square foot, respectively.

The outer surface of the 0.55-inch side window is expected to reach 670 F during reentry from a lunar mission and 830 F during an earth orbit reentry.

Thermal analyses of the SPS disconnect panels show that, with a thermal coating having a solar absorptivity-to-emissivity ratio of 0.52 (emissivity of 0.85), 100 Btu per hour per panel are required to maintain the SPS disconnect panels at a minimum of 40 F under space flight cold-soak conditions. Under these conditions, plus maximum solar energy, panel temperatures will not exceed an upper limit of 250 F. These results indicate that no ON-OFF switch will be required for a thermal control consideration but may be necessary for power considerations.

ELECTRICAL POWER SUBSYSTEMS

Two prototype fuel cell powerplants passed acceptance tests and are scheduled for engineering evaluation tests during December. A third prototype A unit is now undergoing acceptance testing.

Preliminary tests indicate that the 1250 volt-ampere (va) static inverter may have the capability to operate at a 1500-va load. Further testing at a rating above 1250 va was delayed because of changes in the booster stage transformer used to stabilize the firing of silicon control rectifiers in the booster stage. Further tests will be performed during the next report period on both the breadboard and the thermal model.

Vibration tests of the entry battery, housed in a titanium case, were completed. Further dynamic tests, such as acceleration and shock, will be performed and qualification tests of the entry battery are scheduled to begin during the next report period.

The energy requirements for the 14-day lunar orbital rendezvous mission were increased by 5 kilowatt hours (kwhr) to 587 kwhr because of an increased communications duty cycle. The energy required during the entry period was increased by 88 watt hours (whr) to 1064 whr and the post-landing requirement was decreased by 110 whr to 904 whr.

A review of the properties and characteristics of various types of wire and cable insulations confirmed the selection of extruded polytetrofluorethylene (TFE) insulated wire (MB0150-008) for the Apollo spacecraft. A study program is under way to develop a suitable construction in lighter weight MB0150-008 wire for use in the later vehicles.

Circuit interrupters will not be available in time to support manufacturing of boilerplates 18 and 22; for this reason motor switches will be used for this function on these two vehicles. Procurement of these switches was begun.

PROPULSION SUBSYSTEMS

Service Propulsion Subsystems

The F-3 test fixture propellant distribution subsystem was updated to vehicle configuration, and a series of cold flow tests were completed prior to shipment to AEDC for support of the SPS engine simulated altitude tests (scheduled for January 1964).

Fabrication of the propellant retention test reservoir was begun and parts are ready for welding. Weightlessness testing is scheduled to begin upon the arrival of the 8-inch diameter tube and valving.

The first of the SPS propellant tank access door assemblies for the tank qualification program was assembled and hydrostatically tested. The roll swage joints showed no leakage.

During this report period 201 firings were accomplished in the injector development program. Significant accomplishments on prototype-design injectors with ablative chambers include the following:

1. A series of 100 restarts using a 3-second on, 60-second off cycle

2. The first successful firings on the C-11 test stand incorporating the S&ID tank fixture

Table 5 lists all firings made during this report period.

Eight simulated altitude firings were conducted at AEDC during this report period. One firing on the AEDC 2 engine, incorporating the columbium titanium nozzle extension, was terminated because of the failure of the nozzle extension when the cell evacuating system failed to maintain cell pressure. Seven firings on the AEDC 1B engine, incorporating a stainless steel nozzle extension, were conducted to correct AEDC test cell difficulties.

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Table 5. Injector Development Test Program-Apollo Service Propulsion Engine

Serial Number	Pattern Type	Type of Evaluation	Number of Firings	Number of Unstable Firings	Total Firing Time (sec)	Remarks
AFF-12	Doublet, POUL-31-10	High MR survey	7	0	271.0	Satisfactory MR = 2.2.
AFF-13	Doublet, POUL-61-3	C* pattern evaluation	2	0	4.1	Oxidizer pie braze crack
AFF-14	Doublet, POUL-31-10	C* stability	10	0	52.5	Stable
		Injector/chamber compatibility	1	0	201.5	Satisfactory
AFF-17	Doublet, POUL-31-17	Stability-GN_2 injection	3	2	6.0	CSM on first test caused by cracked fuel line at pie segment.
		C* stability	2	2	5.3	CSM shutdowns on both firings. No damage to hardware.
AFF-19	Doublet, POUL-31-16	C* pattern evaluation	10	0	55.0	Stable
		Injector/chamber compatibility	2	0	61.0	Slight streaking noted
		Incremental duration	5	0	848.0	Total time on chamber approximately 900 seconds.
		Stability	100	2	300.0	100 cycles of 3 seconds on, 60 seconds coast. CSM shutdowns occurred on the firings 95 and 99. Ring to land braze.
AFF-18	Doublet, POUL-41-4	C* stability	4	0	21.7	Stable
AFF-20	Doublet, POUL-31-10	C-11 checkout	3	0	52.0	Balance tests
		Low MR survey	8	0	746.0	Includes abort mission duty cycle conducted at MR = 1.8
AFF-21	Doublet, POUL 91-2	C* stability	2	1	8.0	CSM shutdown probably caused by fuel manifold weld crack.
AFF-22	Doublet, POUL-31-10	Induced stability	2	2	3.2	4.9 grain charge
AFF-23	Doublet, POUL-31-10	C* pattern evaluation	1	0	6.0	Satisfactory
AFF-37	Doublet, POUL-31-10	Prototype determination	14	0	875.0	Conducted at elevated chamber pressure
BF-19	Doublet, POUL 41-1	Prototype determination	23	0	514.0	Several eroded areas on chamber wall opposite baffles
AEDC 3	AFF-23, POUL-31-10	Acceptance tests	2	0	42.0	Rough starts and shutdowns
AEDC 2	AFF-4, POUL 51-11	Simulated act. test	1	0	15.0	Col/titanium nozzle extension
AEDC 1B	AFF-24, POUL-31-10	Simulated altitude test	7	0	166.0	Stainless steel nozzle extension. Checkout of cell.

C* = Characteristic exhaust velocity
MR = Oxidizer-to-fuel mixture ratio

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Test requirements for the first seven engines to be used on the F-2 test fixture and the first two engines for spacecraft 001 were completed.

Instrumentation requirements for test fixture F-2 and spacecraft 001 were completed; priorities are now being established. Measurement lists were started for spacecraft 012 and for a standard lunar vehicle.

Service Module Reaction Control Subsystem

The service module panel, four service module RCS engines, and some of the associated hardware were shipped to AEDC for the RCS tests scheduled for 2 December. A preset counter was received and is being integrated into the engine firing test set.

The two service module RCS engine configurations that have provided the greatest pressure spike reduction during the experimental test program will be subjected to further test evaluation. Maximum pressure spikes with each of these configurations were on the order of 750 psig.

Further evaluation of the flat-face injector engine was conducted for both heat transfer and performance. The heat transfer test data showed that the maximum chamber wall temperature was approximately 3100 F, and steady-state performance was comparable with previous 12-on-12 engine data. Pulse performance data are being reduced.

On the first pulse of a projected 5000-pulse series, designed to evaluate the thirteenth doublet injector engine, the thrust chamber was shattered. All effort has been stopped on the use of a thirteenth doublet with the standard 12-on-12 configuration.

Command Module Reaction Control Subsystem

After 90 seconds of a scheduled 100-second continuous run on command module RCS engine 8047, chamber pressure had decreased 15 percent. This engine was the first prototype to incorporate the explosion-proof injector. The engine was sectioned for failure analysis. Examination revealed severe erosion of the combustion chamber liner and loss of the silicon carbide from the throat insert. Characteristic exhaust velocity (C*) performance was approximately 91 percent, 3 percent higher than the average performance of the 9-to-1 engines tested previously.

Engine 8037 was fired to a 15-percent chamber pressure decay, which occurred 170 seconds after successful completion of 60 seconds of acceptance and checkout time and a 100-second mission duty cycle.

The grain structure of the 225 RCS helium tank forgings produced do not meet specification requirements, and an alternate source for new forgings is being investigated. Some of the existing forgings may be usable on nonflight vehicles.

Launch Escape Subsystem Motors

The launch escape and pitch control motor development programs were completed with the successful firing of two escape motors using hotwire cartridges for ignition. The firing of the tower jettison motors AD-20 and AD-21, the last two vibration motors, is scheduled for the next report period and will complete the tower jettison development program.

Launch escape motor ED-14A completed vibration testing and was inspected. The input was 5 g at each end of the motor during the test; an output of 40 g was recorded at the midsection of the motor. Slight propellant flaking was in evidence on the propellant grain surface. However, the motor was fired during the previous report period and no deviations in performance due to this flaking were observed.

Tower jettison motor AD-20 completed the second vibration test without any indication of propellant heating. Motor AD-21, however, had a temperature rise of approximately one degree per minute at both 254 and 283 cps. AD-21 will be vibrated again at the lower frequency of 254 cps to determine whether the temperature rise recurs.

DOCKING AND EARTH LANDING

A successful drop of boilerplate 19 was conducted on 22 October in support of the pad abort test of boilerplate 6. Module dynamics closely approximated those predicted.

Wind tunnel tests on the ringsail main chutes were successfully completed on 16 October.

Pull tests were performed on the 64-inch vehicle harness leg which was removed from boilerplate 19 after the last tests. These pull tests indicated that harness design met specification requirements for boilerplates 6 and 19.

Drop test 56 with boilerplate 1 was conducted on 11 October. Due to either structural flexibility at release, wind conditions, or both, the vehicle did not impact at the proper pitch angle. Visual observations indicated that the horizontal and vertical velocities were not as planned. However, the test was valid in that the test conditions were within the envelope. Two crew couch attenuators bottomed out; these two attenuators and four others were damaged.

Drop 57 was conducted on 28 October using boilerplate 1. Preliminary analysis of the data indicates the following test discrepancies: The pitch angle was 8.5 degrees less than the criteria minimum, and the Z-Z strut compressive loads were 80 percent of design loads.

The air film vehicle for the docking tunnel simulator is 98-percent complete. Only the resurfacing of the air pads remains. The command module/lunar excursion module mock-up tunnel is also complete. Probe and drogue and associated hardware are 50-percent complete. The RCS systems were installed on both of the Phase-I lunar excursion module docking test vehicles. System checkout and initial docking tests are in progress.

GROUND SUPPORT EQUIPMENT (GSE)

An addition of 138 GSE items over the original 350 contract GSE items has raised the total to 488. Since 1 June the model growth rate has averaged 35 models per month. Table 6 shows the status of GSE models and the allocation of responsibility as of 30 October.

Table 6. GSE Engineering Model Summary and Responsibility

Item	Downey	Tulsa	Autonetics	Downey Subcontract	Present Total	Original Total
Model						
Checkout	95	10	25	56	186	98
Auxiliary	42	31	2	17	92	64
Servicing	14	37	0	17	68	54
Handling	91	46	0	5	142	134
Total	242	124	27	95	488	350
Status						
Engineering complete	174	42	0	60	276	
Engineering incomplete	68	82	27	35	212	
Total	242	124	27	95	488	

Engineering tests were completed on the ground telemetry station, and acceptance tests by S&ID were completed, except for tests involving the tape recorder and electromagnetic interference.

A study of the spacecraft instrumentation test equipment (SITE) self-test capabilities, and the depth to which self-test should be accomplished automatically, was continued. The control console front panel layout was rearranged and remechanized to produce self-test tapes. The system design is estimated 65-percent complete.

The breadboard PACE-spacecraft digital test command subsystem, which is the data up-link portion of PACE-spacecraft was delivered to NASA at the Florida facility during the report period. This breadboard will be used as a developmental tool during early phases of the PACE-spacecraft hardware evaluation. Initial tests with the PACE-spacecraft control room computer were successful, confirming the system concept.

The F-2 test fixture shipped to the propulsion system development facility (PSDF) has undergone a normal checkout. Table 7 provides a summary of status of GSE models for F-2.

Table 7. F-2 GSE Model Summary

	Auxiliary	Checkout	Handling	Servicing
Engineering complete	3	13	10	8
Manufacturing complete	1	0	6	0
In work	2	7	4	4
Total required	6	20	20	12

The SPS checkout monitoring remote control rack is the long lead item. It is scheduled to be completed by March 1964. However, to meet MDS 7, an interim unit will be built to support the initial firing scheduled for December 1963.

SIMULATION AND TRAINERS

Preliminary systems engineering performance specifications for the simulator 1 complex (Figure 5) were completed. Effort was begun on the signal flow diagrams, grounding subsystems, functional specifications for each subsystem, and error analyses for simulation/system compatibility.

A NASA review of the simulation visual display subsystems was held at MSC during the report period. It included a review of hardware definition and schedules of the proposed visual systems for both the evaluation

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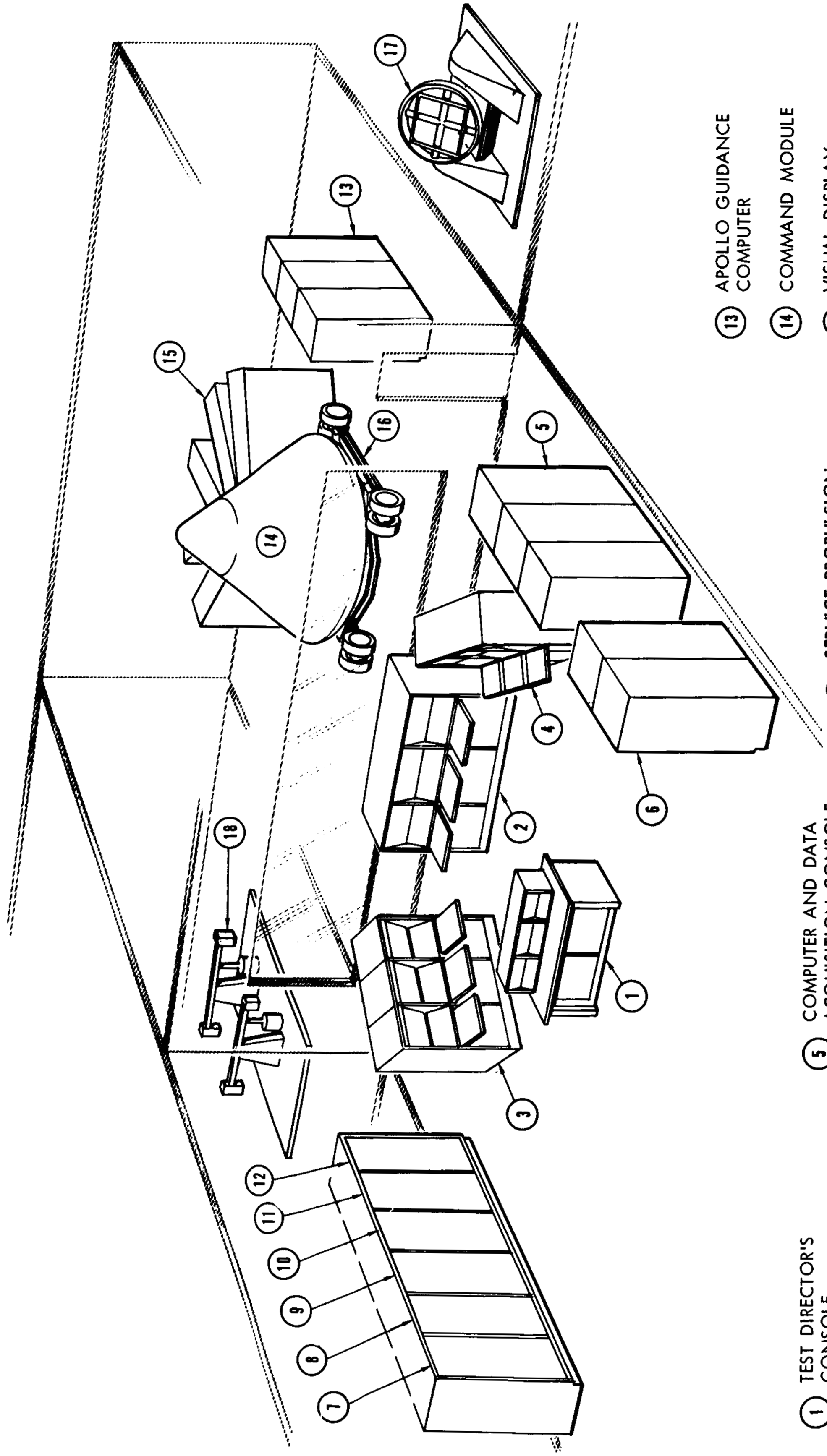

1. TEST DIRECTOR'S CONSOLE
2. TEST CONDUCTOR'S CONSOLE
3. TEST ENGINEER'S CONSOLE
4. TEST COMMUNICATOR CONSOLE
5. COMPUTER AND DATA ACQUISITION CONSOLE
6. VISUAL DISPLAYS AND AUDIO-VIDEO CONTROL
7. POWER
8. TELESCOPE AND SEXTANT
9. SERVICE PROPULSION SYSTEM
10. ENVIRONMENTAL CONTROL SYSTEM
11. CHECKOUT
12. GUIDANCE AND NAVIGATION
13. APOLLO GUIDANCE COMPUTER
14. COMMAND MODULE
15. VISUAL DISPLAY CABINETS
16. SUPPORT AND TILT FIXTURE
17. FLIGHT TABLE
18. SERVICE MODULE ENGINE SIMULATOR

Figure 5. Simulator 1 Complex

and simulator complexes. These systems are designed to provide realistic man-machine simulations where visual cues are required for control or navigation engineering evaluations. The visual cues, which include star-fields, near and far moons and earths, and assorted landmarks, are displayed via out-of-the-window views and simulated sextant/telescope sightings.

Preparations are being made to present a design review on the Apollo part-task trainer (APTT) for NASA on 3, 4, and 5 December. This review will include detailed design data on each system and representative mathematical models, facilities and power, malfunction simulation, and the operation-checkout subsystem.

Procurement specifications and requests for bids to vendors were issued for the APTT computer complex equipment. The machine complement includes analog, special logic, small digital, and analog-digital conversion equipment.

PROJECT INTEGRATION

An Apollo command module humidity study was instituted as a result of the electrical equipment failure on Mercury MA-9. The first phase of this study indicated that there are major spacecraft subsystems located in the crew compartment which were not designed for operation in the presence of corrosive moisture. The design of the ECS does not guarantee complete humidity control, such as the elimination of moisture due to condensation. The second phase of this study, a detailed study of all electrical/electronic components to the lowest level, has just been completed. Design changes are under consideration to ensure adequate protection of all components from degradation by environmental exposure.

Concurrently, the ECS was analyzed with the objective of determining system changes and additions, such as the addition of a heat pump, necessary to assure complete dew-point control. Also considered were several minimum-weight ECS changes, selected to minimize condensation. Steps to implement these studies are being evaluated.

VEHICLE TESTING

Air drop 7 using boilerplate 19 was the final constraint drop for boilerplate 6 launch. The drop was made from an altitude of 13,000 feet, and the vehicle stabilized in an apex forward condition. The auxiliary parachute was disconnected at 10,000 feet, and normal recovery sequence was initiated. Deployment of all parachutes and final recovery of the vehicle were completely successful. This drop was preceded by extensive ground tests in which all parachutes were manually deployed to provide final prove-out of changes resulting from the failure analysis of boilerplate 3, drop 5.

Three land impact tests were accomplished with boilerplate 1. In each test the vehicle was impacted into a hard packed upslope with normal parachute sink speeds combined with high horizontal speeds (51 feet per second). The roll attitudes at impact were 70 degrees, 110 degrees, and 180 degrees, respectively. In the latter two attitudes, the vehicle tumbled and came to rest with the hatch up and clear, but some damage to the interim crew shock struts was incurred. In the 70-degree attitude, the vehicle did not tumble and the crew support system performed satisfactorily.

Boilerplate 6 accomplished the pad abort mission during the report period. The flight trajectory appeared to be as predicted. The command module landed 8200 feet and 20 degrees east of north from the launch point. All subsystems appeared to operate within design tolerances. Table 8 shows flight sequences as follows:

Table 8. Boilerplate 6 Pad Abort Flight Sequences

Sequence	Seconds Predicted	Seconds Actual
LES and pitch control motor ignition		
LES motor burnout	8.0	8.8
Tower and apex jettison	15.5	15.6
Drogue parachute deployment	18.5	18.6
Pilot parachute	23.5	24.0
Main parachute disreef	33.5	32.3
Command module landing	157.0	165.1

Visual observations indicated that vehicle stability was approximately as predicted. Tower jettison occurred near apogee at a near-horizontal attitude angle. Little or no yaw oscillations were experienced. There was a slow positive roll during LES motor burning, followed by a slow negative roll after motor burnout, with the total roll angle at tower jettison being near zero degrees. Pictures indicate that after tower jettison the command module oscillated from about a zero-degree to a 45-degree angle-of-attack in three seconds, the point of drogue initiation. After drogue deployment, the command module initially oscillated from about a 45-degree to a 240-degree angle-of-attack.

Deployment and inflation of the parachutes occurred as expected. There was no apparent damage to the main parachutes. There were no abrasions or cuts on any bridle or riser components, and there was no evidence of contact with the command module deck. The command module landed in an upright attitude, and the only apparent damage was a shift of the aft Fiberglas heat shield about three-eighths inches in the -Z direction. Post-flight inspection indicated that all pyrotechnics had discharged. All explosive bolts functioned as planned.

Data were recorded on all tracks of the airborne tape recorder and by all telemetry stations on both continuous and commutated functions. Preliminary data analysis indicates that data trends were as expected on all 85 data channels.

RELIABILITY

A coordination meeting on the reliability objectives of the Apollo mission was held with Grumman. Minimum mission objectives were defined and the command/service module rendezvous capability in the event of a lunar excursion module rendezvous failure with respect to minimum orbital altitude was established.

The minimum mission success objectives, as recommended by Grumman, defined the lunar stay time as four hours. The S&ID interpretation of achieving mission success was the completion of a lunar exploration of approximately 30 minutes' duration following a required post-landing lunar excursion module checkout period of approximately 75 minutes. This would result in a minimum 1.75-hour lunar surface stay in order for a safe abort to become a mission success. The latter interpretation was acceptable to Grumman, although it was agreed that the nominal profile to be used for computing mission success would contain a planned lunar excursion module lunar stay of four hours, with a safe abort after 30 minutes of lunar exploration being considered a successful mission.

A proposed mission profile was developed, but it does not extend beyond lunar excursion module crew transfer to the command/service module, because the determination of the transearth trajectory will require significant reliability and performance trade-off studies.

At a recent mission planning panel meeting with NASA it was agreed to waive the requirement of the lunar excursion module direct abort capability during the lunar excursion module coasting orbit. The present inability of the lunar excursion module to perform direct aborts during coasting orbits could preclude achievement of the crew safety objectives. It was therefore recommended that this requirement be maintained until impact on crew safety can be determined.

Since the first preliminary design review on the ECS, there have been several major design changes (the deletion of regenerative heat exchangers, the addition of a carbon dioxide bypass line in the suit circuit, and the deletion of the reentry oxygen supply subsystem). A second design review of this system covered the suit circuit, the oxygen supply, and the command module pressure and temperature control subsystem. The following are action items resulting from this review.

1. Incorporation was recommended of a cut-off control in the carbon dioxide absorber unit bypass line, for use in the emergency mode only.

2. The check valve located in the oxygen supply line can fail in an undetectable open position, allowing catastrophic loss of both oxygen storage tanks if a leak in the same oxygen line were to occur in the service module. It was recommended that a study be made to determine whether an additional valve could be located so that a crew member could prevent this type of catastrophic failure.

3. It was recommended that a study be made on the carbon dioxide absorber unit release mechanism, to clarify the override capability of the poppet-type bleed valve and to assure that the release mechanism can be operated by a gloved hand.

4. Clarification is needed of the programming of metabolic heat loads during manned ECS tests. A review of methods for the simulation of work tasks was recommended.

The board recommended that the proposed designs be approved, contingent upon the satisfactory resolution of the above action items.

A preliminary study of the unmanned suborbital mission assigned to spacecraft 009 was completed. The study included reliability predictions for the entire mission and for the attitude and systems programmer, a compilation of related logic diagrams, and the test requirements to qualify the programmer. The predicted mission reliability for the command and service modules, excluding the recovery phase, is 0.9535. This is based on a reliability prediction for the programmer of 0.99897. A complete apportionment study will be initiated as additional reliability data become available for the S-I and S-IV boosters.

OPERATIONS

DOWNEY

The boilerplate 12 service module was moved to the Apollo Test and Operations test preparation area where the power-on checkout was completed. The launch escape subsystem, the command module, and the service module were accepted, and modifications were started.

The boilerplate 12 Q-ball failed vibration testing and was returned to the subcontractor. The spare Q-ball was assigned to boilerplate 12 following the successful launch of boilerplate 6. This Q-ball will be used for checkout of boilerplate 12.

The command module, service module, and adapter for boilerplate 13 were moved to the ATO test preparation area where the development engineering inspection was completed.

Breadboard continuity for boilerplate 15 checkout has been completed.

Safety criteria requirements are being developed for cryogenics handling, storage, and usage during spacecraft 008 environmental proof testing at the NASA-MSC. Apollo Test and Operations has compiled the detailed requirements for modifications of individual systems for environmental-chamber testing at MSC.

The component instrumentation checkout for the telemetry ground station has been completed, and acceptance testing is complete except for the tape recorder and reproducers. The rooftop antenna installation has been completed.

The astronaut coordination unit has completed the entry trajectory evaluation portion of the Apollo manned centrifuge program at Johnsville centrifuge facility.

During the next period, test preparation of boilerplates 12 and 13 will be completed, and checkout will be started. The determination of the data handling concept for the NASA-MSC will be completed. Coast and maneuver, boost and abort, and guidance and navigation simulations at S&ID will also be completed.

WHITE SANDS MISSILE RANGE

The boilerplate 6 earth landing system buildup and the weight and balance checks were completed during the report period. The boilerplate was taken to the launch pad and mated to the adapter. After individual systems tests, the last integrated systems test was completed. The simulated countdown, the second integrated systems test, the flight readiness inspection, and the countdown were completed.

The mission abort flight of boilerplate 6 was launched on schedule at 0900 hours (MST) on 7 November 1963. The flight proceeded as planned with no discrepancies. Ignition of the launch escape motor and the pitch control motor occurred simultaneously. After burnout of the launch escape motor, some flame continued to come from the motor nozzles through the tower jettison stage. Tower jettison occurred on schedule. Drogue deployment was as planned and properly positioned the boilerplate for main chute system deployment. The pilot chutes deployed the main chutes evenly, and inflation appeared simultaneously. Descent was uneventful, and the landing was successful. The boilerplate remained upright after touchdown. The only apparent damage was a slight deformation to the heat shield. All systems functioned properly.

After the launch, the boilerplate was removed to the vertical assembly building (VAB) and given post-flight checkout. The boilerplate was then prepared for shipment to S&ID.

Test Fixture F-2 arrived at WSMR and passed receiving inspection. Spares for the fixture have been shipped to WSMR. The 72-hour and the 48-hour pressure maintenance checks and the hydroset validation are continuing for the fixture. The adapter ring has been delivered to the propulsion systems development facility.

During the next period, the mission abort pad and the blockhouse areas for boilerplate 12 testing will be prepared. The weight and balance fixture and test console for S&ID rework will be shipped to S&ID.

FLORIDA FACILITY

The detailed test plan for boilerplate 15 has been prepared.

The Florida facility hangar AF bench maintenance area has been activated and is now supporting prelaunch automatic checkout equipment (PACE) breadboard tests.

A resolution is required regarding the test requirement of firing the live pyros during a launch pad checkout.

During the next period, preparation of the USAF hangar and launch complex 37 for arrival of boilerplate 13 will be continued.

FACILITIES

DOWNEY

Systems Integration and Checkout Facility

Recent rains have damaged portions of the gypsum board ceiling in the mid high bay ceiling, requiring replacement. Replacement time is not expected to affect the beneficial occupancy date (BOD). The total project is 69 percent complete.

Space Systems Development Facility—Part I

Erection of concrete tilt-up panels began during the report period, and erection of structural steel is scheduled to start November 18. The main portion of the building is 22 percent complete.

Space Systems Development Facility—Part II

The facility is complete with the exception of punch list deficiencies. Completion is scheduled during the next period.

Building 6 Modifications and Data Ground Station

Building 6 modifications were completed during the report period. Only punch list items remain to be completed. Incorporation of design modifications to the Data Ground Station were authorized and the remaining construction is scheduled to be completed in January 1964.

INDUSTRIAL ENGINEERING

GFY 1964 Facilities Appendix A

The brick and mortar portion of the GFY 1964 Facilities Appendix A was completed and submitted for publication during the period for delivery to NASA.

S-IVB Adapter

Written approval has been received by NASA to manufacture the S-IVB adapter at the S&ID Tulsa facility and to fund the large autoclave as special tooling.

Lunar Excursion Module Docking Test Facility Proposal

A facilities proposal is being prepared for the lunar excursion module docking test program. Definitions of the construction and facilities equipment necessary have been completed.

APPENDIX

S&ID SCHEDULE OF APOLLO MEETINGS AND TRIPS

S&ID Schedule of Apollo Meetings and Trips
16 October to 15 November 1963

Subject	Location	Date	S&ID Representatives	Organization
Management progress briefing	Hartford, Connecticut	16 October	Wermuth, Van Camp	S&ID, Pratt & Whitney
Stabilization and control panel meeting	Houston, Texas	16 October	Antletz, Campbell, Frost, Woosley, Murad	S&ID, NASA
Instrumentation concept presentation	Houston, Texas	16 October	Aber, Wilkens, McCuen, Clauder, Woody, Garing	S&ID, NASA
Trainer meeting	Houston, Texas	19 October	Hatchell	S&ID, NASA
Phase-I test program review	Tullahoma, Tennessee	20 October	Field, Cadwell, Hackett	S&ID, NASA
Command-service module/lunar excursion module test briefing	Houston, Texas	20 October	Gustavson, Severine, Pope	S&ID, NASA
Master change negotiation	Niagara Falls, New York	20 October	Hobson, Whiting	S&ID, Bell Aerosystems
Engineering representation at Boilerplate 6 prelaunch operations	WSMR	20 October	Garcia	S&ID, NASA
Facilities and training meeting	Houston, Texas	20 October	Hatchell	S&ID, NASA
Interface coordination meeting	Houston, Texas	21 to 22 October	Gustavson, Crouch, Richardson	S&ID, NASA
Boilerplate 22 status review	Houston, Texas	21 October	Wolff, Crowder	S&ID, NASA
Test preparation sheets coordination	WSMR	21 October	Chiapuzio	S&ID, WSMR
Test panel meeting	Houston, Texas	21 October	Gilbert, Burke, Fagan	S&ID, NASA
Contract problems discussion	AMR	21 October	Brown	S&ID, NASA
Test panel meeting	Houston, Texas	21 October	Harvey, Rutkowski, Sweeney, Spengler, Witt, Gustavson	S&ID, NASA
Field analysis negotiation	Middletown, Ohio	21 October	Stover	S&ID, Aeronca

S&ID Schedule of Apollo Meetings and Trips 16 October to 15 November 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
PACE breadboard developmental test	AMR	21 to 22 October	Stott, Marbory	S&ID, NASA
Technical meeting and review	Woodside, Long Island	22 October	Matisoff	S&ID, Avien
Subcontractor review	Malden, Massachusetts	22 October	Frankhouse	S&ID, Lawson Tool
2kmc high-gain antenna discussion	Woodside, New York	22 October	Womack, Holmberg, Matisoff	S&ID, Avien
H_2 pump failure investigation	Malden, Massachusetts	22 October	Anderson	S&ID, Lawson Machine
Programming meeting	Houston, Texas	22 October	Schwarzmann, Dorsey, Gebhardt, Wellens	S&ID, NASA
Scientific instrumentation payload discussion	Ellington Air Force Base	22 October	Collier, Oliver	S&ID, USAF
SCS end item acceptance test	Minneapolis, Minnesota	22 October	Jarvis, Purkey	S&ID, Honeywell
FS-3 wind tunnel tests	Tullahoma, Tennessee	22 October	Daileda	S&ID, NASA
Fuel cell test stand design review	Hartford, Connecticut	23 October	Waltz	S&ID, Pratt & Whitney
RCS test coordination meeting	Houston, Texas	23 October	Brandel	S&ID, NASA
Communication system review	Cedar Rapids, Iowa	23 October	Stanley, Hudelson	S&ID, Collins Radio
Design coordination meeting	Elkton, Maryland	23 October	Yee, Sumner	S&ID, Thiokol
SCS weights detail review coordination	Minneapolis, Minnesota	23 October	Gasparre, Frost	S&ID, Honeywell
Astronaut briefing	Cambridge, Massachusetts	23 October	Smith	S&ID, MIT
Apollo checkout panel meeting	Houston, Texas	23 October	McMullin, Cooper, Shelley	S&ID, NASA
Technical coordination meeting	Phoenix, Arizona	23 October	Kolb	S&ID, Motorola

S&ID Schedule of Apollo Meetings and Trips 16 October to 15 November 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
SCS systems packaging	Houston, Texas	23 October	Levine	S&ID, NASA
Investigation of system installation	Sacramento, California	24 October	Lewin	S&ID, Aerojet-General
Qualification burst test	Indianapolis, Indiana	24 October	Brehaut, Furman	S&ID, Allison
Additional funding support	NASA	25 October	Weller	S&ID, NASA
Dynamic centrifuge test runs observation	Johnsville, Pennsylvania	25 October	Kahn	S&ID, USN
Coordination	Boulder, Colorado	26 October	Meyer	S&ID, Beech
SCS acceptance test procedures	Minneapolis, Minnesota	27 October	Stiles, McLennan	S&ID, Honeywell
Monitoring team representation	Long Island City, New York	27 October	Flegal, Wishon	S&ID, Alderson Research
Boilerplate 6 integrated system checkout review	WSMR	27 October	Nobles	S&ID, WSMR
Supervise and direct test preparations	WSMR	27 October	Pearce	S&ID, WSMR
Boilerplate 19 reballast	El Centro, California	27 October	Kessler	S&ID, El Centro Naval Air Station
Design activity coordination	Sacramento, California	27 October	Mower	S&ID, Aerojet-General
Fuel cell powerplants operational test procedures	Hartford, Connecticut	27 October	Orr	S&ID, Pratt & Whitney
Management coordination	Scottsdale, Arizona	27 October	Hagelberg, Blakeley, Shear	S&ID, Motorola
IFTS proposal and program plan fact-finding meeting	Chicago, Illinois	27 October	Puterbaugh, Smith Bartholomew	S&ID, ITT

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S&ID Schedule of Apollo Meetings and Trips
16 October to 15 November 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
ECS Meeting	Houston, Texas	28 October	Kinsler, Duncan, Stelzriede, Merhoff	S&ID, NASA
Boilerplate 19 modification	El Centro, California	28 October	Bean, Widener, Gibbs	S&ID, USN
PACE breadboard test support	AMR	28 October	Turner	S&ID, NASA
Boilerplate 12 test point conference	Houston, Texas	28 October	Helms	S&ID, NASA
Fuel cell test stand design review	Hartford, Connecticut	28 October	Waltz	S&ID, Pratt & Whitney
PACE breadboard developmental test	AMR	28 October	Lackey, Byrkit, Truelove	S&ID, NASA
Centrifuge test program conduction	Johnsville, Pennsylvania	29 October	Hornick, Shelton	S&ID, AMAL
Bell systems evaluation	Hartford, Connecticut	29 October	Pohlen, Nelson, Nash	S&ID, Pratt & Whitney
GSE design review meeting—service propulsion system	Sacramento, California	29 October	Ross	S&ID, Aerojet-General
NASA/Bell Laboratories and BELCOM meeting	Hartford, Connecticut	29 October	Pohlen	S&ID, Pratt & Whitney
Motion simulator program review	Shawnee, Oklahoma	30 October	Brown	S&ID, Shawnee Industries
Schedule review	Boulder, Colorado	30 October	Carter, Collins	S&ID, Beech
Closure simulator investigation	Denver, Colorado	30 October	Barnett	S&ID, Martin
LES canard system review	Houston, Texas	30 October	Moore	S&ID, NASA
NASA TPS and field EO's discussion	WSMR	30 October	Robertson, Highland	S&ID, WSMR
Automated Apollo missions	Houston, Texas	30 October	Kehlet, Hogan, Sobek Dolan, Erlick	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
16 October to 15 November 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Parachute drop tests	El Centro, California	30 October	Trebes	S&ID, Parachute Test Group
Toxicology, radiation, and microbiology meeting	Houston, Texas	30 October	Hair, Edgerley, Sofios	S&ID, NASA
Program status review	Boulder, Colorado	30 October	Collins, Carter	S&ID, Beech
GOSS fly-over test and installation	Greenbelt, Maryland	30 October	Beatty	S&ID, Goddard
Acceptance test	Metuchen, New Jersey	30 October	Kluth	S&ID, Applied Electronics
SCS acceptance test procedures	Minneapolis, Minnesota	31 October	Garcia, Fiore	S&ID, Honeywell
In-flight test maintenance presentation	Houston, Texas	31 October	McCarthy, Cole, Vucelic, Myers, Levine, Cureton	S&ID, NASA
Apollo technical status discussion	Houston, Texas	31 October	Benner, Dodds, Skene	S&ID, NASA
Boilerplate 6 test preparation	WSMR	31 October	Pearce	S&ID, NASA
Central timing equipment coordination meeting	Rolling Meadows, Illinois	1 November	Schiavi, Covington, Cason	S&ID, Elgin
Temperature control coatings information	Palo Alto, California	1 November	Evins, Urode, Rosenfield, Jay	S&ID, Lockheed
Technical coordination	Bethpage, Long Island, New York	1 November	Bologna	S&ID, Grumman
FDAI simulator familiarization briefing	Minneapolis, Minnesota	3 November	Smith	S&ID, Honeywell
Definitive contract negotiation	Tarrytown, New York	3 November	Haeggstrom, Gleason, Wagner, Bratfisch, Gardiner	S&ID, Simmonds/ Precision Products
GSE technical coordination	Princeton, New Jersey	4 November	Kolb	S&ID, RCA

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S&ID Schedule of Apollo Meetings and Trips
16 October to 15 November 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Program status review and problem discussion	Minneapolis, Minnesota	4 November	Dyson, Maxwell	S&ID, Honeywell
Apollo crew systems meeting	Houston, Texas	4 November	Brewer, Tarr Opdyxe	S&ID, NASA
FD-6 model pre-test conference	Mountain View, California	4 November	Takvorian, Udvardy	S&ID, NASA
Aerodynamic status force tests conduction	Mountain View, California	4 November	Moote	S&ID, Ames Research Center
Management review	Minneapolis, Minnesota	4 November	Mihelich	S&ID, Honeywell
Apollo television camera coordination meeting	Princeton, New Jersey	5 November	Eberhart, Green Forrette	S&ID, RCA
Reentry plasma effects meeting	Houston, Texas	5 November	Strelow, Daniels	S&ID, NASA
Parachute drop tests	El Centro, California	5 November	Young	S&ID, Parachute Test Group
NASA wire test review	Houston, Texas	5 November	Proctor	S&ID, NASA
Centrifuge test program coordination	Johnsville, Pennsylvania	5 November	Campbell	S&ID, NADC/ AMAL
Electrical power systems meeting	Houston, Texas	5 November	Champaign, Haglund, Nichols, Snyder, Hopkins	S&ID, NASA
Spacecraft 008 GSE coordination meeting	Houston, Texas	5 to 6 November	Embody, Davis, Garing	S&ID, NASA
Boilerplate 6 Launch	WSMR	6 November	Huffman	S&ID, NASA
Lunar excursion GSE systems meeting	Houston, Texas	6 November	Richardson, Schauers, Corvese	S&ID, NASA
EMS system discussion	Houston, Texas	6 November	Johnson, Knotts, Carter	S&ID, NASA

S&ID Schedule of Apollo Meetings and Trips
16 October to 15 November 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Boilerplate 6 test and report preparation	WSMR	7 November	Wiltse	S&ID, NASA
Dynamic stability test program	Sacramento, California	7 November	Field, Cadwell	S&ID, Aerojet-General
Boilerplate 22 and 23 differences presentation	Houston, Texas	7 November	Wolff	S&ID, NASA
Contract negotiations	Sacramento, California	7 November	Briggs, Flynn	S&ID, Aerojet-General
Management reevaluation	Buffalo, New York	7 November	Toomey, Hobson, Williams, Gibb, Whiting	S&ID, Bell Aerosystems
ECS breadboard test program presentation	NASA	7 November	Sheere, Griffith, Lasslo	S&ID, NASA
Technical assistance for negotiation of contract changes	Sacramento, California	7 November	Colston	S&ID, Aerojet-General
Design coordination	Houston, Texas	7 November	Boothe, Rose	S&ID, NASA
Procurement and cleaning specifications discussion	San Carlos, California	7 November	Augsburg, Langager, Lazarus, Errington	S&ID, Pelmec
Apollo manned centrifuge program participation	Johnsville, Pennsylvania	8 November	Montgomery	S&ID, USN
Acceptance tests evaluation	Mesa, Arizona	8 November	Fisher	S&ID, Talley Industries
Manned centrifuge runs	Johnsville, Pennsylvania	11 November	Eggers	S&ID, AMAL
Test program review	WSMR	11 November	Field, Bauserman, Gallanes, Holmes, Kishner	S&ID, NASA
Boilerplate 13 GSE installation verification	AMR	11 November	Dorman, Williams	S&ID, NASA

S&ID Schedule of Apollo Meetings and Trips
16 October to 15 November 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Glass coating specification coordination	Santa Rosa, California	11 November	Chinn	S&ID, Optical Coating Lab
Unified S-band acceptance test	Scottsdale, Arizona	11 November	Hall	S&ID, Motorola
Crew safety system panel meeting	Houston, Texas	11 November	Vucelic, Pringle, Geheber	S&ID, NASA
Lunar excursion module mechanical systems meeting	Houston, Texas	11 November	Brown	S&ID, NASA
Little Joe and PSDF sites coordination	WSMR	11 November	Stolper, Morrill, Suddarth, Harkins	S&ID, NASA
TVC failure effects studies and rendezvous analysis	Minneapolis, Minnesota	11 November	Tutt, Oglevie	S&ID, Honeywell
Mechanical systems meeting	Houston, Texas	12 November	Nicholas, Markel, Sweet, Walkover	S&ID, NASA
Engineering conference	Hampton, Virginia	12 November	Lofland	S&ID, NASA
Development igniter cartridge firings	Elkton, Maryland	12 November	Yee	S&ID, Thiokol
Management coordination meeting	Cedar Rapids, Iowa	13 November	Hagelberg	S&ID, Collins
Coordination meeting - reliability review	Cedar Rapids, Iowa	13 November	Pope, Page, Dorrell, McCandless, Hall, Webster, Marine, Murad, Rose, Renfroe	S&ID, Collins
PSTL-2 static pressure model tests	Mountain View, California	13 November	Snowden	S&ID, Ames Research Center
Radar boresight range equipment design review	Atlanta, Georgia	13 November	Griffiths, Eden	S&ID, Scientific-Atlanta
Task design and analysis digital program discussion	Bethpage, Long Island, New York	15 November	Epstein	S&ID, Grumman

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